HITACHI

MODEL VR-3510/3525/3550
DIGITAL MULTIMETER

SERVICE MANUAL

File: H34

Hitachi Denshi, Ltd.
TOKYO, JAPAN

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NOTICE

This Service Manual describes the most typical product of this model. If there are any specific differences between this Manual and the servicing unit, please contact Hitachi Denshi sales office in your area.

MODEL VR-3510/3525/3550
DIGITAL MULTIMETER
Service Manual

1. SPECIFICATIONS

1. 1 General specifications

Withstanding voltage (COM to ground)	±500V DC or AC rms
Sampling rate	Approx. 2 times/sec.
Display	3-1/2 digit LCD panel display
Displayed information	Units display: mV, V, μA, mAA, Ω, kΩ, MΩ Battery display: B AC measurement annunciator: AC Continuity check annunciator: •)) Diode test measurement display: ⊣◀ Overload display: Leftmost "1" only is displayed Polarity display: For negative values only
Operating method	Dual-slope integration
Battery life	Normally 500 hours with manganese dry cells (for voltage and current measurements.) The low battery indication, B, appears on the display when about 20 % of the battery life remains.
Power supply	Type AA batteries (2)
Dimensions	86(W) x 32(H) x 174(D) mm (3.4 x 1.3 x 6.9 in)
Weight	Approx. 270g (9.5oz) (not including batteries)
Operating temperature	0 to + 40 °C (+32 to +112 °F)
Temperature range for guaranteed accuracy of all specifications	+18 to +28 °C (+65 to +82 °F)
Humidity	80% RH or less (0 to 35 °C) 70% RH or less (0 to 40 °C)

1. 2 Electrical specifications

The performance listed below applies to instruments calibrated on a half year cycle and operated in the temperature range of 18 to 28 °C (65 to 82 °F) with a humidity of 80 % or less.

(1) DC voltage

Model	VR-3510	VR-3525	VR-3550
Range switching	Auto-ranging and manual selection		
Resolution			
200mV range	0.1mV		
2000mV range	1mV		
20V range	10mV		
200V range	100mV		
1000V range	1V		
Accuracy ±(% of reading + No. of digits)			
200mV range	0.1% + 2	0.25% + 2	0.5% + 2
2000mV range	0.1% + 1	0.25% + 1	0.5% + 1
20V range	0.1% + 1	0.25% + 1	0.5% + 1
200V range	0.1% + 1	0.25% + 1	0.5% + 1
1000V range	0.1% + 1	0.25% + 1	0.5% + 1
Auto-ranging	Accuracy listed above is for the range used.		
Input impedance	1000 MΩ or higher for the 200 mV range 11 MΩ for the 2000 mV range, and 10 MΩ for all other ranges.		
Normal mode rejection	Better than 55 dB at 50/60 Hz		
Response time	1 sec. or less (except for auto-ranging)		
Excessive voltage protection	1100V DC or 850V AC rms		
Temperature coefficient ± (% of reading + No. of digits)/°C	(0.02% + 0.1)/°C	(0.025% + 0.1)/°C	(0.03% + 0.1)/°C

(2) AC Voltage

Model	VR-3510	VR-3525	VR-3550
Range switching	Auto-ranging and manual selection		
Resolution 2000mV range 20V range 200V range 750V range	 1mV 10mV 100mV 1V		
Accuracy (all ranges) ±(% of reading + No. of digits)	0.75% + 3	0.75% + 3	1% + 5
Measurement frequency response	45 to 500 Hz		
Input impedance	11MΩ in the 2V range and 10MΩ in all other ranges.		
Conversion method	Average measurement (rms value is calibrated for a sinewave signal)		
Response time	2 sec. or less (except for auto-ranging)		
Excessive voltage protection	1100V DC or 850V AC rms		
Temperature coefficient ±(% of reading + No. of digits)/°C	(0.05 % +0.2)/°C		

(3) Resistance

Model	VR-3510	VR-3525	VR-3550
Range switching	Auto-ranging and manual selection		
Resolution			
200Ω range	100mΩ		
2000Ω range	1Ω		
20kΩ range	10Ω		
200kΩ range	100Ω		
2000kΩ range	1kΩ		
20MΩ range	10kΩ		
Accuracy ±(% of reading +No. of digits)			
200Ω range	0.2% + 3	0.25% + 3	0.5% + 3
2000Ω range	0.2% + 1	0.25% + 1	0.5% + 1
20kΩ range	0.2% + 1	0.25% + 1	0.5% + 1
200kΩ range	0.2% + 1	0.25% + 1	0.5% + 1
2000kΩ range	1% + 1	1% + 1	1% + 1
20MΩ range	2% + 3	2% + 3	2% + 3
Auto-ranging	Accuracy that listed above is for the range used.		
Response time	1sec. or less in the range less than 200 kΩ, 3 sec. or less in the 2000kΩ range, and 8 sec. or less in the 20MΩ range. (Response time depends upon the resistance value for auto-ranging).		
Maximum circuit voltage	1.5V ± 0.25V in the 200Ω range, and 0.65V ±0.1V for the 2000Ω and higher ranges		
Maximum voltage within a range	0.15V or less in the 200Ω range, 0.37V or less for the 2000Ω or higher ranges.		
Maximum test current			
200Ω range	0.7mA or less		
2000Ω range	0.1mA or less		
20kΩ range	30μA or less		
200kΩ range	4μA or less		
2000kΩ range	0.4μA or less		
20MΩ range	0.04μA or less		
Overload protection	0.2A/250V fuse protection		
Temperature coefficient ±(% or reading + No. of digits)/°C			
200Ω to 200kΩ range	(0.025%+ 0.2)/°C	(0.025%+ 0.2)/°C	(0.03% + 0.2)/°C
2000kΩ range	(0.05% + 0.2)/°C	(0.05% + 0.2)/°C	(0.05% + 0.2)/°C
20MΩ range	(0.1% + 0.2)/°C	(0.1% + 0.2)/°C	(0.1% + 0.2)/°C

(4) DC Current

Model	VR-3510	VR-3525	VR-3550
Range switching	Manual only		
Resolution			
200μA range	0.1μA		
2000μA range	1μA		
20mA range	10μA		
200mA range	100μA		
10A range	10mA		
Accuracy ±(% of reading + No. of digits)			
200μA range	0.75% + 1	0.75% + 1	1% + 1
2000μA range	0.75% + 1	0.75% + 1	1% + 1
20mA range	0.75% + 1	0.75% + 1	1% + 1
200mA range	0.75% + 1	0.75% + 1	1% + 1
10A range	2% + 1	2% + 1	2% + 1
Response time	1sec. or less		
Effect of internal voltage drop			
200μA range	250mV (max.)		
2000μA range	250mV (max.)		
20mA range	250mV (max.)		
200mA range	750mV (max.)		
10A range	200mV (max.)		
Excessive current protection (A input)	0.2A/250V Fuse protection		
Excessive current protection (10A input)	Up to 10A		
Temperature coefficient ±(% of reading + No. of digits)/°C	(0.05% + 0.1)/°C		

(5) AC Current

Model	VR-3510	VR-3525	VR-3550
Range switching	Manual only		
Resolution			
200μA range	0.1μA		
2000μA range	1μA		
20mA range	10μA		
200mA range	100μA		
10A range	10mA		
Accuracy ±(% of reading + No. of digits)			
200μA range	1.2% + 3	1.2% + 3	1.5% + 5
2000μA range	1.2% + 3	1.2% + 3	1.5% + 5
20mA range	1.2% + 3	1.2% + 3	1.5% + 5
200mA range	1.2% + 3	1.2% + 3	1.5% + 5
10A range	3% + 3	3% + 3	3% + 5
Frequency response	45 to 500 Hz		
Conversion method	Average measurement (rms value is calibrated for a sinewave signal)		
Response time	2 sec. or less		
Effect of internal voltage drop			
200μA range	250mV (max.)		
2000μA range	250mV (max.)		
20mA range	250mV (max.)		
200mA range	750mV (max.)		
10A range	200mV (max.)		
Excessive current protection (A input)	0.2A/250V Fuse protection		
Excessive current protection (10A input)	Up to 10A (non-fuse protection)		
Temperature coefficient ±(% of reading + No. of digits)	(0.1% + 0.2)/°C		

(6) Continuity

Model	VR-3510	VR-3525	VR-3550
Range	The 200Ω range is automatically selected regardless of which range is chosen.		
Threshold	20Ω ± 50%		
Response time	100msec.		
Overload protection	0.2A/250V Fuse protection		

(7) Diode Test

Model	VR-3510	VR-3525	VR-3550
Range	0 - 1000mV		
Test current	0.6mA ± 30%		
Accuracy	±(5% of reading +1 digit)		
Response time	1 sec. or less		
Overload protection	0.2A/250V Fuse protection		

(8) Temperature (Applicable only to the VR-3510 and VR-3525)

Model	VR-3510	VR-3525
Sensor	K(CA) Thermocouple	
Measurement range	-20 °C to +700 °C (using a special probe)	
Resolution	1 °C	
Accuracy	±(2% of reading + 2 °C)	
Overvoltage protection	0.2A/250V Fuse protection	
Temperature coefficient	±(0.05% of reading + 0.2 °C)/ °C	
Probe	Model 4261: Temperature probe (-20 to +700 °C protector tube type) Model 4262: Temperature probe (-20 to +200 °C protector tube type) Model 4263: Temperature probe (-20 to +600 °C surface sensor type)	

2. CONFIGURATION

The configuration of the Hitachi VR-3510, VR-3525 and VR-3550 digital multimeters are as follows.

(1) Multimeter 1
(2) Batteries (type AA) 2
(3) Test leads ..... 1 set
(4) Spare fuse (200 mA/250 V) 1
(Contained in the battery housing)
(5) Instruction manual 1

3. CALIBRATION

The VR-3510, VR-3525, and VR-3550 are completely calibrated before shipping, but due to changes with time, or repairs, calibration and adjustment may be necessary. Adjustments are done in the same way as 3, Electrical Performance Tests.

3. 1 Calibration

Calibration requires standard instruments similar to those listed Table 3-1. Calibration should be performed at room temperatures of 18 °C to 23 °C (64 to 75 °F).

Table 3-1

INSTRUMENT TYPE	RANGE	ACCURACY
Voltage Calibrator	0 to +1000V DC	0.01 % or better
	0 to +750V AC rms (+45 to +500 Hz)	0.05 % or better
Current Calibrator	0 to +200 mA DC	0.05 % or better
	0 to +10 A DC	0.1 % or better
	0 to +200 mA AC (+45 to +500 Hz)	0.1 % or better
	0 to +10 A AC (+45 to +500 Hz)	0.1 % or better
Reference Resistance	0 to +20 MΩ	0.05 % or better

3. 2 Calibration method

Calibration is performed in the steps listed in Table 3-2.

Positions of controls are shown in Fig. 3-1. VR-3550 calibration is performed through step 5.

Table 3-2

Step	Calibration Item	Function	Range	Input Signal	Component for Calibration	Display Reading
1	DC	DC Voltage	200 mV	190 mV	VR-4	189.9 to 190.1
			2000 mV	1900 mV	VR-1	1899 to 1901
2	AC	AC Voltage	200 mV	1900 mV (100 Hz)	VR-6	1899 to 1901
3	Continuity	Continuity	-	20 Ω	VR-2	(The beep should sound)
4	Temperature measurement	TEMP	-	Short	VR-5	(Use sparate thermometer to detect room, and adjust display to the room temperature.)
			-	0.64 mV	VR-3	Room temperature +(489 to 511)
5	-	-	-	1.3V ± 0.075V (Battery Voltage)	VR-7	("B" appears on the display)

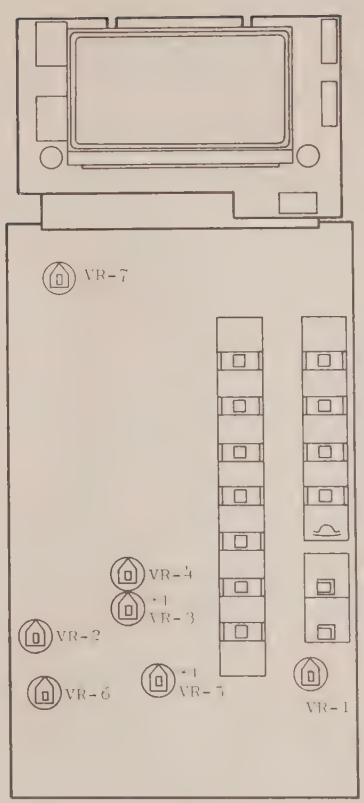


Fig. 3-1 Positions of controls

*1: Applicable only to the VR-3510 and VR-3550

4. ELECTRICAL PERFORMANCE TEST

An electrical performance test of the unit is performed according to the following.

(1) Room temperature should be 23 ±5 °C (73 + 9 °F), and humidity below 80 % (RH) during testing.

(2) Check fuses and batteries.

(3) Remove test leads, turn on power, and set at each function.

(4) Standard instruments for tests are listed in Table 3-1.

4. 1 Voltage test

Perform according to following procedures.

(1) Connect standard instrument as shown in Fig. 4-1.

(2) Perform steps listed in Table 4-1, and confirm that all indicators of the unit are within these ranges. AC measurement is performed by sinewave.

NOTE: In the 200 mV range, in order to test linear characteristics, input ±10 mV and ±100 mV. Here, the external resistors and LSI performance are tested.

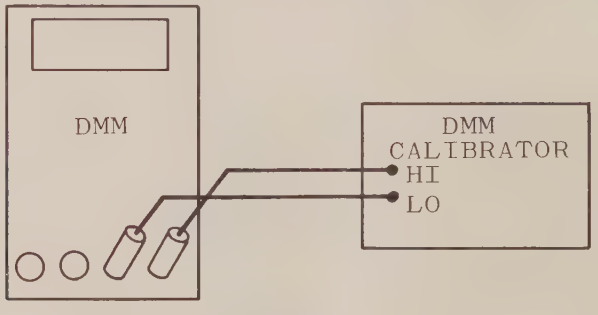


Fig. 4-1

Table 4-1 Voltage Test

Step	Function	Range	Input Signal		Display Limits			Item Confirmed
			Level	f (Hz)	VR-3510	VR-3525	VR-3550	
1	DC V	200 mV	0 mV	DC	-0.2 to 0.2	0.0 to 0.2	0.0 to 0.2	"mV" lighting
2			10.0 mV		9.7 to 10.3	9.7 to 10.3	9.7 to 10.3	
3			-10.0 mV		-9.7 to -10.3	-9.7 to -10.3	-9.7 to -10.3	
4			100.0 mV		99.7 to 100.3	99.5 to 100.5	99.3 to 100.7	
5			-100.0 mV		-99.7 to -100.3	-99.5 to -100.5	-99.3 to -100.7	
6			190.0 mV		189.6 to 190.4	189.3 to 190.7	1888 to 1912	
7			-190.0 mV		-189.6 to 190.4	-189.3 to -190.7	-1888 to -1912	
8		2000 mV	0 mV	DC	-0.1 to +0.1	-0.1 to +0.1	-0.1 to +0.1	
9			1900 mV		1897 to 1903	1894 to 1906	1889 to 1911	
10			-1900 mV		-1897 to -1903	-1894 to -1906	-1889 to -1911	
11		20 V	19.00 V	DC	18.97 to 19.03	+18.94 to +1906	18.89 to 19.11	"V" lighting
12			-19.00 V		-18.97 to -19.03	-18.94 to -1906	-18.89 to -19.11	
13		200 V	190.0 V	DC	189.7 to 190.3	189.4 to 189.4	188.9 to 191.1	
14			-190.0 V		-189.7 to -190.3	-189.4 to -189.4	-1889 to -191.1	
15		1000 V	1000 V	DC	998 to 1002	996 to 1004	994 to 1000	
16			-1000 V		-998 to -1002	-996 to -1004	-994 to -1006	
17	AC V	2000 mV	0		0 to 3		0 to 5	"AC·mV" lighting
18			10 mV	100	6 to 14		4 to 16	
19			100 mV	100	96 to 104		94 to 106	
20			1000 mV	100	989 to 1011		985 to 1015	
21			1900 mV	100	1882 to 1918		1876 to 1924	
22				500	1882 to 1918		1876 to 1924	
23		20 V	19.0 V	45	18.82 to 19.18		18.76 to 19.24	"V" lighting
24				500	18.82 to 19.18		18.76 to 19.24	
25		200 V	190 V	45	188.2 to 191.8		187.6 to 192.4	
26				500	188.2 to 191.8		187.6 to 192.4	
27		750 V	750 V	45	741 to 759		737 to 763	
28				500	741 to 759		737 to 763	

4. 2 Current test

Follow the procedures below.

(1) Connect standard instrument as shown in Fig. 4-2.

(2) Set to current function, and perform steps shown in Table 4-2.

NOTE: The linear characteristics of the LSI's A/D convertor, and the frequency characteristics of the rectifier circuit are performed with the voltage measurement test, and so are omitted here. Only the external resistors of the current measurement circuit are tested. Use the separate terminal for 10 A current measurement.

Table 4-2 Current Test

Step	Function	Range	Input Signal		Display Limits			Item Confirmed
			Level	f(Hz)	VR-3510	VR-3525	VR-3550	
1	DC A	200 μA	190 μA	DC	188.4 to 191.6		1880 to 192.0	"μA" lighting
2			-190 μA		-188.4 to -191.6		-188.0 to -192.0	
3		2000 μA	1900 μA		1884 to 1916		1880 to 1920	
4		20 mA	19 mA		18.84 to 19.16		18.80 to 19.20	"mA" lighting
5		200 mA	190 mA		188.4 to 191.6		188.0 to 192.0	
6		10 A	10 A	DC	9.79 to 10.21		9.77 to 10.23	"A" lighting
7	AC A	200 μA	190 μA	45	187.4 to 192.6		1866 to 1934	"μA·AC" lighting
8			"	500	187.4 to 192.6		"	
9		2000 μA	1900 μA	100	1874 to 1926		1866 to 1934	
10		20 mA	19 mA		18.74 to 19.26		18.66 to 19.34	"mA·AC" lighting
11		200 mA	190 mA		187.4 to 192.6		186.6 to 193.4	
12		10 A	10 A		9.67 to 10.33		9.67 to 10.33	"A·AC" lighting

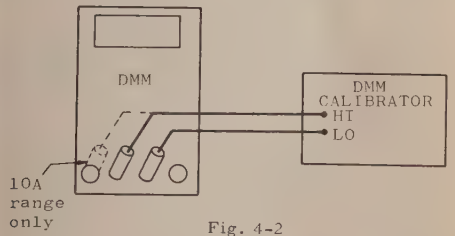


Fig. 4-2

4. 3 Resistance and continuity tests

Perform according to the following steps.

(1) Connect standard instruments as shown in Fig. 4-2.

(2) Perform steps shown in Table 4-3. The continuity test is performed by changing the resistance with rated supply voltage, and measuring at which point the beeper starts to sound.

Table 4-3 Resistance and Continuity Tests

Step	Function	Range	Input Resistance	Display Limits			Item Confirmed
				VR-3510	VR-3525	VR-3550	
1	Resistance	200 Ω	0 (Short)	0 to 3	0 to 3	0 to 3	"Ω" lighting
2			190 Ω	189.3 to 190.7	189.2 to 190.8	1887 to 1913	
3		2000 Ω	0	0 to 1	0 to 1	0 to 1	
4			1900 Ω	189.5 to 1905	1894 to 1906	1889 to 1911	
5		20k Ω	19k Ω	18.95 to 19.05	18.94 to 19.06	18.89 to 19.11	"kΩ" lighting
6		200k Ω	190k Ω	189.5 to 190.5	189.4 to 190.6	188.9 to 191.1	
7		2000k Ω	1900k Ω	1879 to 1921	1879 to 1921	1879 to 1921	
8		20M Ω	19M Ω	18.59 to 19.41	18.59 to 19.41	18.59 to 1941	"MΩ" lighting
9	Continuity			10 to 30	10 to 30	10 to 30	

4. 4 Test of diode function test

Using the method shown in Fig. 4-3, check that the displayed values and the values of Vx are within 5 % of each other.

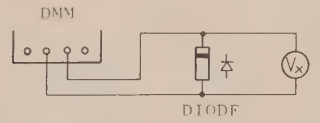


Fig. 4-3

4. 5 Temperature measurement test (Applies to VR-3510/3525 only)

Perform according to the following prpcedures.

(1) Connect the standard instrument as shown in Fig. 4-2.

(2) Perform steps shown in Table 4-4.

NOTE: The temperature measurement test is actually performed without changing the real temperature; the output voltage of the thermocouple with respect to a certain temperature is generated from the standard instrument and read the display. The display limits are the values shown in the table minus the room temperature.

Table 4-4 Temperature Measurement Test

Step		Input Voltage (DC)	Display	
			VR-3510	VR-3525
1	0 °C	Short	-2 to 2	
2	-20 °C	-1.156 mV	-17 to -23	
3	-10 °C	-0.777 mV	-7 to -13	
4	50 °C	2.022 mV	47 to 53	
5	100 °C	4.095 mV	96 to 104	
6	200 °C	8.137 mV	194 to 206	
7	300 °C	12.207 mV	292 to 308	
8	400 °C	16.395 mV	390 to 410	
9	500 °C	20.640 mV	488 to 512	
10	600 °C	24.902 mV	586 to 614	
11	700 °C	29.128 mV	684 to 716	

5. HOW TO DISASSEMBLY

To disassemble the unit, perform the following procedures, using the composition assembly diagram as reference.

(1) Remove tapping screws shown in page 35 .

(2) Since the top case and bottom case are connected by the shielded wires, buzzer, etc., keep them only in a several centimeters apart for separation.

(3) Remove the tapping screws shown in page 35 , and separate the buzzer and the top case.

(4) Disconnect the two shielded wires connected to the top and bottom case from the shielding connector pins.

Notes: 1. For disassembly, always start by disconnecting test leads, cutting off power, and removing batteries.

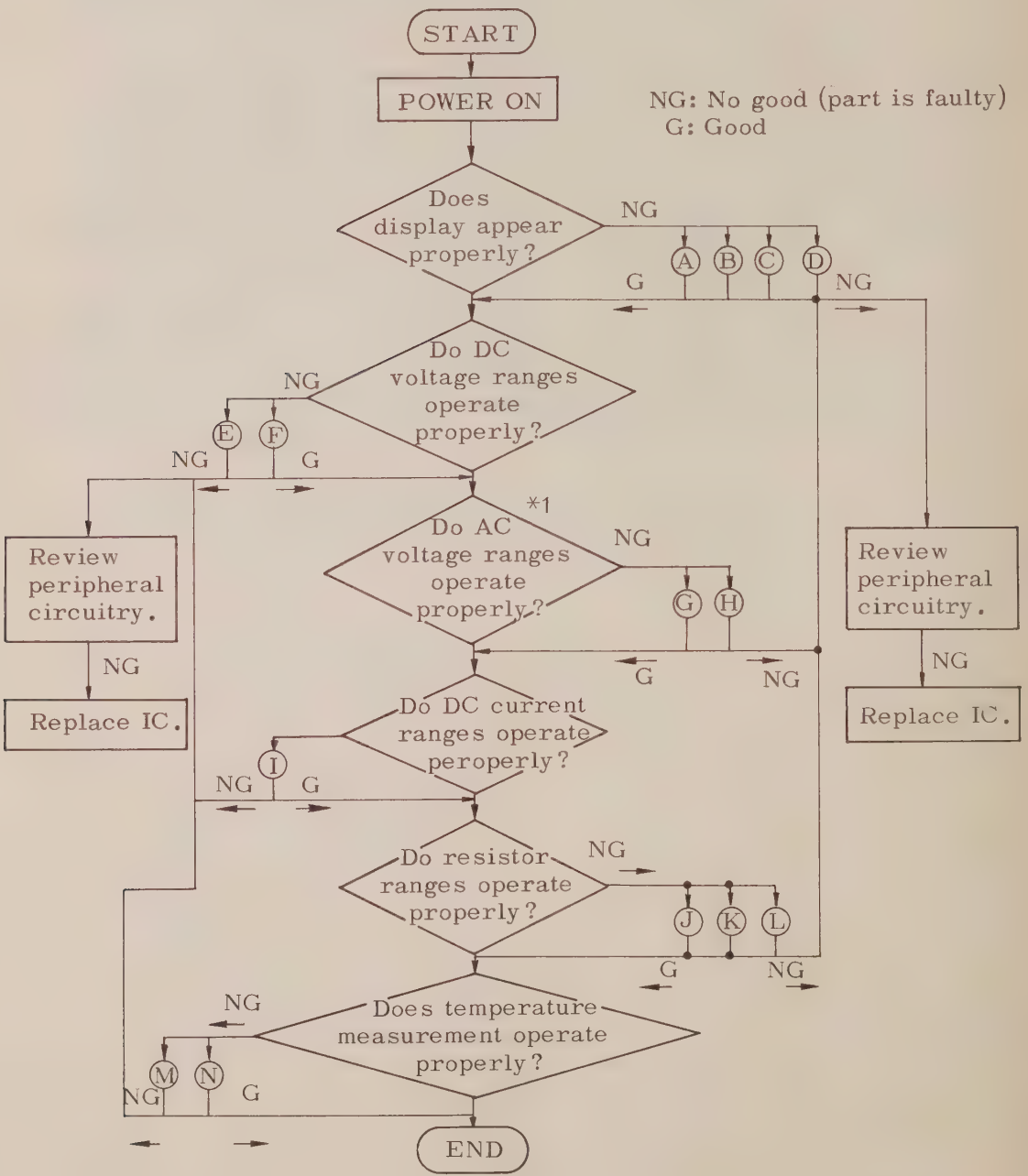
2. The LSI is very vulnerable to static electricity, so take extreme caution in handling it. Use a extractor to remove it.

3. When cleaning the printed circuit board, always use an agent of 1.1.1-Trichloroethane such as chlorothene sold in the USA.

4. Since the case is made of plastic (ABS), it is sensitive to volatile cleaners, and thinners, etc., should not be used for cleaning.

6. TROUBLESHOOTING

Perform troubleshooting according to the following flow chart. Check the items listed in circled capital letter designation according to the material in Table 6-1. Use Table 6-1 by checking the item concerned; if it is in proper operating order, the fault may lie in another place, so proceed to the next item. When the cause of problem is found, perform procedure listed at the right of chart.



NOTE) As stated in the principle of operation, several means of protection are used to prevent the flow of excessive current to the IC. Thus, even if a current in excess of ratings is allowed to flow for a long period of time, at worst, damage should effect only the parts other than IC's. Thus, even in cases of damage caused by factors outside of those listed alphabetically, it does not necessarily mean that the IC is faulty. Peripheral circuitry should be rechecked thoroughly. Especially be sure to check the connections between that peripheral circuitry and the IC.

*1. The AC voltage check also satisfies AC current check.

Table 6-1

Item	Symptom	Faulty part	Check procedure	Cause of trouble	Measure
Ⓐ	No display at all.	Power circuit	(1) Measure battery voltage.	Low battery	Replace batteries
			(2) Measure voltage between C21 ⊕ and COM, C22 ⊖ and between COM. If the voltages are + (1.5 ± .2 V) and - (1.5 ± .2V), condition is normal.	Battery contacts faulty.	
				Slide switch (S14-1, S14-2) faulty	Replace slide switch.
Ⓑ	Only a part of display does not appear.	Display section	Perform continuity test between IC pins (37) through (51), and their corresponding LCD terminals. Check the continuity.	Soldering faulty (Note: The correspondence between IC pins and LCD terminals is as follows: IC 37, 38 ... correspond to LCD terminals 1, 2, ... from the right).	Resolder to have all the components in proper continuity.
Ⓒ	One section of display does not appear.	Display section	(1) Perform continuity test between IC pins (52) through (54) and their corresponding LCD terminals.	Soldering faulty	Resolder to have all the components in proper continuity.
			(2) Set to 2000 mV range, make input terminal open, and measure voltage between LCD terminals pin 1 through 18 (from left) and COM. If the results of Table 6-2 are obtained, the LCD is faulty.	LCD faulty	Replace LCD
			(3) Check to see whether crystal resonator oscillating properly, (1024 Hz).	X1 faulty	Replace X1.
Ⓓ	Display differs from selected function.		Measure voltage of IC pins (25) through (27) (F5 to F3). Normal if in accord with Table 6-3.	Contacts of S2, S3, S12, S13 faulty	Replace switches.
Ⓔ	Display value is regularly 1/10, 1/100 ... or 10x, 100x ... the actual input (or range does not change).		Measure voltage of IC pins (18) through (20) (R1 to R3). If in accord with Table 6-3, normal.	D8 through D17 faulty (S7 to S12 faulty)	Replace diode (replace switch).

Item	Sympton	Faulty part	Check procedure	Cause of trouble	Measure
Ⓕ	Display value is unrelated to input. (DC voltage)	DC voltage input section	(1) Measure resistance between V terminal and IC pin (74) (V_{IN}). If approx. 10 MΩ, normal.	R1, R2, VR1, Z1 faulty	
		Reference voltage generating circuit	(2) Measure voltage between IC pin (5) and (6). (REF LO, HI). 164 mV (reference voltage) normal. If Q3 is faulty and always OFF, will be approx. 68 mV. Fault may also lie in DZ, VR3, VR4.	Q3, DZ faulty. VR3, VR4 out of adjustment	Replace Q3, DZ. Readjust VR3. VR4. (in accord with 3-2 calibration method).
			(3) Check parts such as voltage divider circuit, capacitor for integration (C19), etc. (These are checked when input and display are substantially different).		
Ⓖ	Display value is unrelated to input. (AC voltage)	Rectification circuit (AC-DC converter)	(1) Without attaching any input, set on AC voltage function, and measure voltage of IC pin (65). Normal it approx. 0 V.	R47 faulty	Replace R47.
			(2) Input a sinewave (45 - 500 Hz) of 1 V or more, and measure wave shape between IC pin (11) (AVX 1) and (58) (AVX 2). Normal condition should show a DC rectification wave. AVX 2 should be on ground side. If D20 or D21 are faulty, and a short or open condition exists, DC wave will not attained.	D20, D21 faulty	Replace D20, D21.
			(3) If cause of problem is other than Nos. (1) (2) above, recheck AC-DC converter section.		Check all parts of AC-DC converter section, and replace all faulty parts.

Item	Sympton	Faulty part	Check procedure	Cause of trouble	Measure
Ⓗ	Does not switch from DC function to AC function.			S5 faulty	Replace switch.
Ⓘ	When input is changed, display remains at zero. (DC current)	Power input section	Check fuse.	Fuse shorted	Replace fuse.
			Check D1 to D4.	Diode is shorted.	Replace diode.
Ⓙ	Display value and input are unrelated (or ϕ).	Current Shunt		R3 to R7 faulty S7 to S11 faulty	Replace faulty parts.
Ⓚ	Does not become ϕ even when leads are shorted. Or displays excessive value even when the leads are open.		Measure test current between COM·Ω-A terminals. If current is flowing, condition is normal.	Q1 is shorted. PTC is open. Fuse is blown.	Replace Q1, PTC, Fuse.
Ⓛ	On continuity test, beeper does not sound even when continuity is present.			Beeper is disconnected.	Replace beeper.
Ⓜ	When set to temperature function, displays ϕ and not the room temperature.		Measure voltage at IC pin ⑩ (AGS). If normal, not equal to (0 ± 0.1 mV), when set to temperature function.	Q4, Q5, S1, S12	Replace faulty parts.
Ⓝ	When set to same as above, displays 400 to 500, or -160 to -180.		Check D7.	D7 faulty	Replace D7.

Table 6-2

Pin number (from left)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DMM measurement value (AC mV). (Average value measurement sinewave at time or calibration.)	550	550	1280	~	~	~	~	~	~	~	~	~	1280	550 (1280)	550	910	~	910

Table 6-3

Range			R1	R2	R3
Voltage	Current	Resistance			
200 mV(DC)	200 μA	200 Ω	H	L	L
2000 mV	2000 μA	2000 Ω	L	H	H
20 V	20 mA	20k Ω	L	L	H
200 V	200 mA	200k Ω	H	L	H
1000 V(DC) 750 V(AC)	-	2000k Ω	L	L	L
-	10 A	20M Ω	H	H	L
AUTO	-	AUTO	H	H	H

L: -1.5 V
H: 0 V

	F3	F4	F5
Voltage	H	H	L
Current	H	H	H
Resistance	L	H	H
Diode test	H	L	H

Note • AC-DC switching. When measuring voltage or current, each time F-1 is placed on "L," AC and DC are switched.

• Ω -continuity check switching. When measuring resistance, each time F1 is placed on "L," Ω and continuity checks are switched. Also, if F6, F9 are on "L," continuity check will be selected only when F1 is on "L." Further, on continuity check, it is set at a 200.0 Ω fixed range.

7. PRINCIPLE OF OPERATION

The Hitachi Digital Multimeter VR-3510, 3525 or, 3550 consists of the analog switch section, control section, A/D switching section, and liquid crystal display driver section all of which are included in an LSI, MSM 5230GS.

Other parts including the AC/DC switching, current shunt, voltage divider, reference resistors for resistance measurements, function and range switches, are external components of the LSI.

(1) MSM5230G

The LSI MSM5230GS is an 80 pin flat package LSI including an auto-ranging circuit (excluding current range), driver for liquid crystal display, diode circuit, beeper circuit for continuity checks, and low-battery detector circuit. The major switches for selecting functions and resistor range are arranged inside the LSI, and the selection of functions and ranges is controlled from the outside by the logic level. The operation of the LSI is as follows: First, inputs are all changed to direct current voltage, and digitalized by the A/D converter section. The lower three digits of output are latched as 4-bit BCD (binary-coded decimal) data, and the upper one digit is latched as 3-bit data. Passing through the decoder and LCD (Liquid Crystal Display) driver, LCD display is performed. The functions of each terminal is indicated in Table 7-1.

Table 7-1 LSI Functions

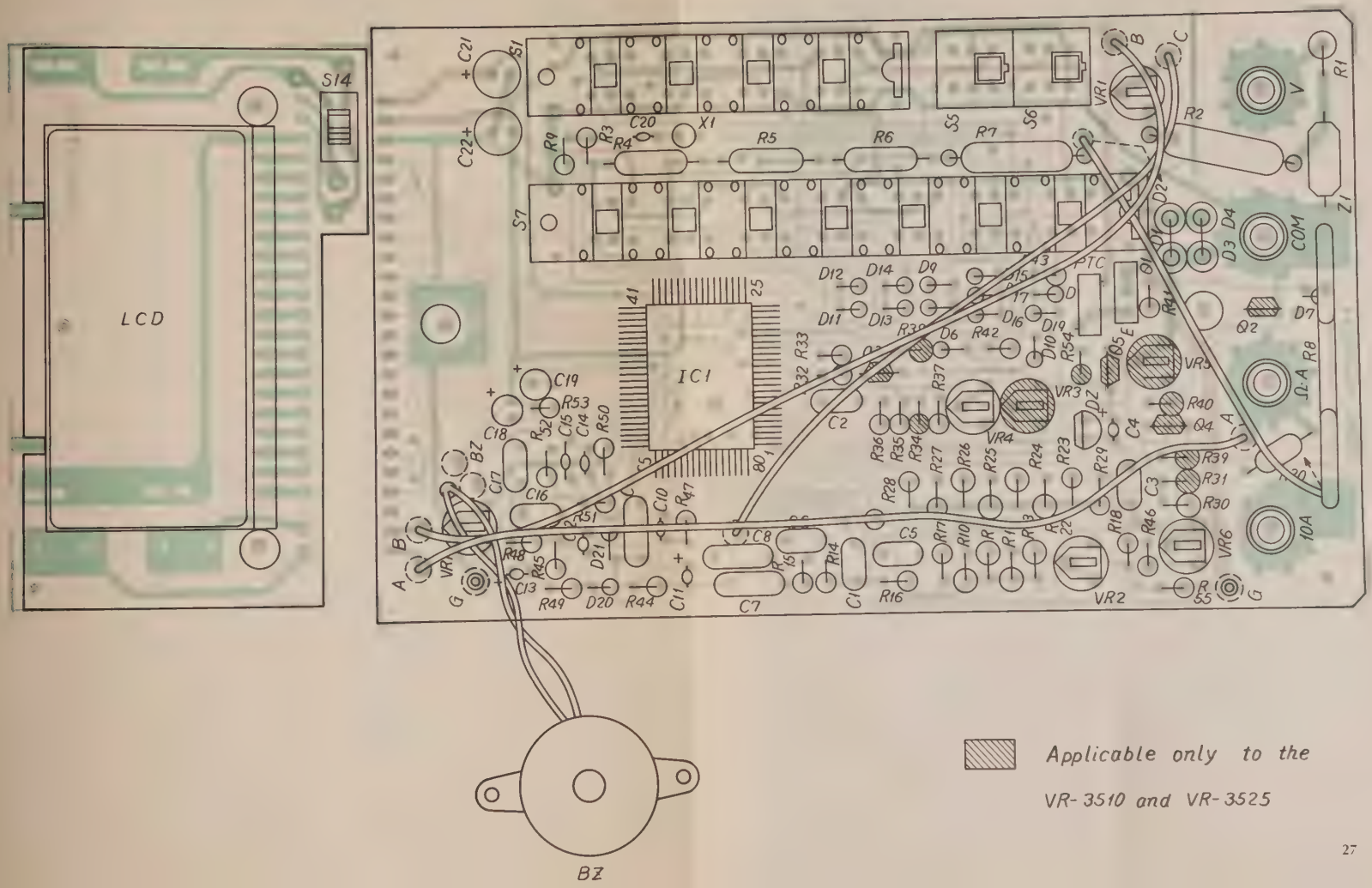
Name	Pin No.	Function
RR4	1	Reference resistor connection terminal for 200.0 kΩ
RR3	2	Reference resistor connection terminal for 20.00 kΩ
RR2	3	Reference resistor connection terminal for 2000 Ω
RR1	4	Reference resistor connection terminal for 200.0 Ω
VRIN2	5	Reference voltage neg. side input
VRIN1	6	Reference voltage pos. side input
CR2	7	Capacitor connecting terminal for reference voltage storage
CR1	8	Capacitor connecting terminal for reference voltage
RVS	9	Reference resistance voltage drop input
AGS	10	Analog section grounding
AVX1	11	All-wave rectification circuit pos. side output connecting
RI2	12	High resistance connector terminal for integration
RI1	13	Low resistance resistor connecting terminal for integration
VSSA	14	Analog section neg. power supply
VSS	16	Digital section neg. power supply
F2	17	Auto/manual and manual range selector signal input terminal
R1	18	Range setting signal 1 input
R2	19	Range setting signal 2 input
R3	20	Range setting signal 3 input
F9	21	Function setting signal 2 input
F6	22	Function setting signal 1 input
F8	23	Clamp meter setting signal and "AC" mark illumination input
F1	24	AC/DC and Ω/continuity check selector signal
F5	25	External range control signal input
F4	26	Function setting signal 1 input
F3	27	Function setting signal 3 input

Name	Pin No.	Function
F7	28	Display holding signal input
BZ	29	Beeper connection
OSC1	30	Crystal oscillator connection
OSC2	31	Crystal oscillator connection
VDD	15 32	Positive power supply
CKOUT	33	Internal clock (1024 Hz) output
DATA	34	Data output
DE	35	Data timing output
VSSL	36	LCD drive section neg. power supply
SEG15	37	LCD panel segment 15 connection
SEG14	38	LCD panel segment 14 connection
SEG13	39	LCD panel segment 13 connection
SEG12	40	LCD panel segment 12 connection
SEG11	41	LCD panel segment 11 connection
SEG10	42	LCD panel segment 10 connection
SEG 9	43	LCD panel segment 9 connection
SEG 8	44	LCD panel segment 8 connection
SEG 7	45	LCD panel segment 7 connection
SEG 6	46	LCD panel segment 6 connection
SEG 5	47	LCD panel segment 5 connection
SEG 4	48	LCD panel segment 4 connection
SEG 3	49	LCD panel segment 3 connection
SEG 2	50	LCD panel segment 2 connection
SEG 1	51	LCD panel segment 1 connection
COM1	52	LCD panel back-plane 1 connection
COM2	53	LCD panel back-plane 2 connection
COM3	54	LCD panel back-plane 3 connection
CCH2	55	Capacitor connection terminal for voltage doubler
CCH1	56	Capacitor connection terminal for voltage doubler
VCR	57	Voltage doubler output

Name	Pin No.	Function
AVX2	58	Full-wave rectification neg. output
CAZ	59	Capacitor connection terminal for auto zero
C1	60	Capacitor connection terminal for integration
COMP	61	Comparator output
VROUT	62	Internal reference voltage output terminal
VRADJ	63	Internal reference voltage adjustment terminal Connect control between V_{ROUT} and V_{RADJ} and between V_{RADJ} and AG.
AG	64	Analog section ground terminal
AOUT	65	Amp output terminal for AC/DC conversion. Connect feedback resistor and full-wave rectification circuit.
AGN2	66	Amp. phase inversion input terminal for AC/DC conversion. Connect feedback resistor and full-wave rectifier circuit.
AIN1	67	Amp. same-phase input terminal for AC/DC conversion. Connect DC blocking capacitor and full-wave rectifier circuit.
I I N	68	Input terminal for current measurement. Current is converted to voltage and input so that each range is 200.0 mV at each maximum value.
VR5	69	Voltage dividing resistor connection terminal for AC 750 V, DC 1000 V range
VR4	70	Voltage dividing resistor connection terminal for 200.0 V range
VR3	71	Voltage dividing resistor connection terminal for 20.00 V range
VR2	72	Voltage dividing resistor connection terminal for 2000 mV range
VIN	73	Input terminal for voltage measuring
CCUT	74	DC blocking capacitor connection terminal for AC/DC conversion

Name	Pin No.	Function
RVX	75	Input terminal for voltage drop of measured resistance and voltage input terminal for diode check
CF1	76	Capacitor connection terminal for noise suppression
VCH	77	Voltage input terminal for beeper judgement level adjustment
RD1	78	Voltage dividing resistor connection terminal for diode check
RR6	79	Reference resistor connection terminal for 2000 MΩ range
RR5	80	Reference resistor connection terminal for 2000 kΩ

8. ELECTRICAL PARTS ARRANGEMENT



9. ELECTRICAL PARTS LIST

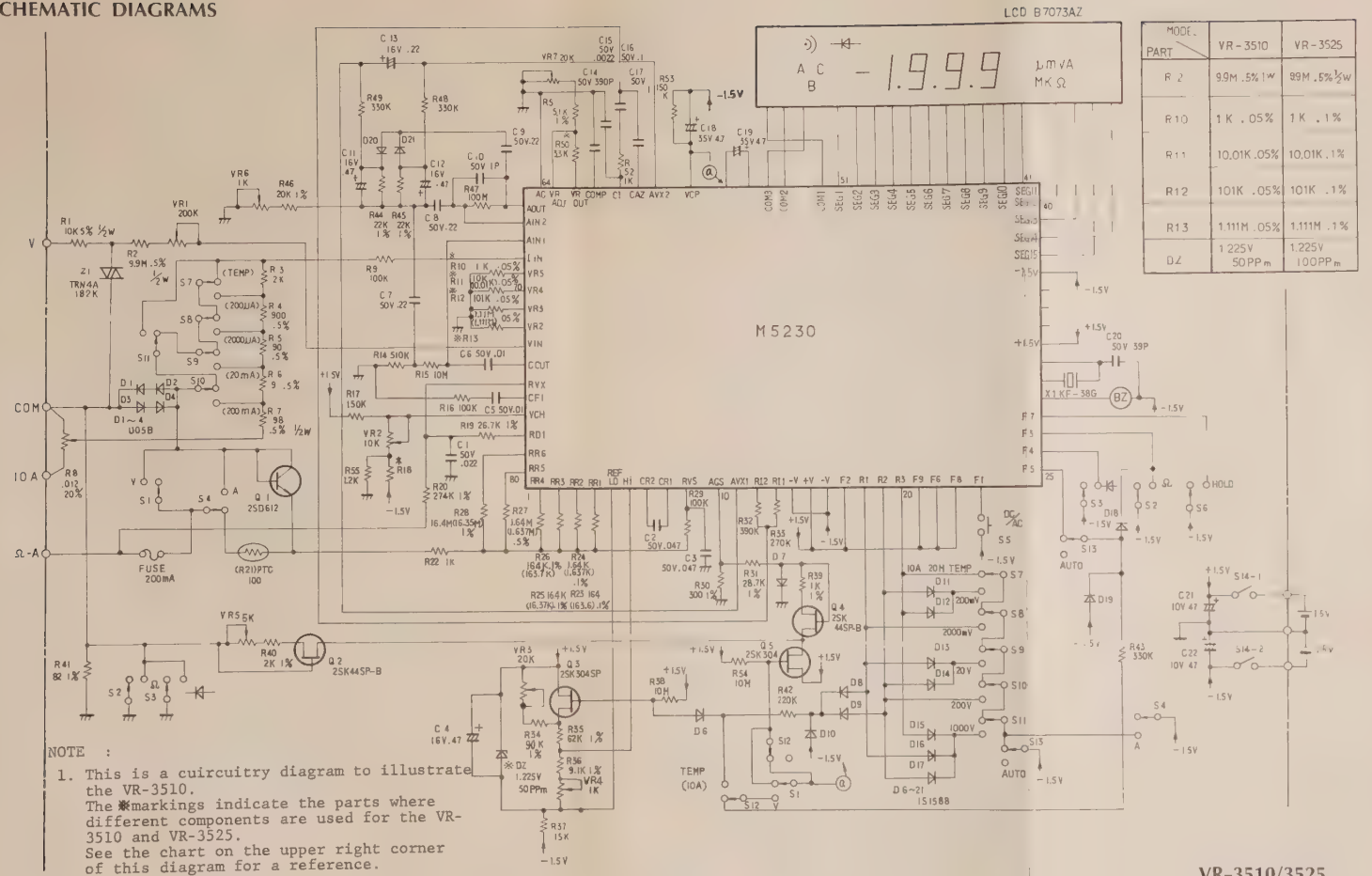
Note
A:VR-3510/ B:VR-3525/ C:VR-3550

Symbol	Part Code	Description				Q'ty A	Q'ty B	Q'ty C
R 1	RSE0445	R. Solid	1/2W	10kΩ	±5%	1	1	1
2	RMM0448	R. Metal	0.2W	9.9MΩ	±0.5%	1		
2	RMM0449	R. Metal	0.08W	9.9MΩ	±0.5%		1	1
3	RCR3285	R. Carbon	1/4W	2kΩ	±5%	1	1	1
4	RMM0421	R. Metal	1/4W	900Ω	±0.5%	1	1	1
5	RMM0420	R. Metal	1/4W	90Ω	±0.5%	1	1	1
6	RMM0419	R. Metal	1/4W	9Ω	±0.5%	1	1	1
7	RMR3785	R. Metal	1/2W	0.98Ω	±0.5%	1	1	1
8	BSZ0001	CNW-A	DT-860			1	1	1
9	RCR3326	R. Carbon	1/4W	100kΩ	±5%	1	1	1
10	RMM0423	R. Metal	1/2W	1kΩ	±0.05%	1		
10	RMM0422	R. Metal	1/2W	1kΩ	±0.1%		1	
10	RMM0447	R. Metal	1/4W	1kΩ	±0.25%			1
11	RMM0424	R. Metal	1/2W	10.01kΩ	±0.05%	1		
11	RMM0425	R. Metal	1/2W	10.01kΩ	±0.1%		1	
11	RMM0426	R. Metal	1/4W	10.01kΩ	±0.25%			1
12	RMM0427	R. Metal	1/2W	101kΩ	±0.05%	1		
12	RMM0428	R. Metal	1/2W	101kΩ	±0.1%		1	
12	RMM0429	R. Metal	1/4W	101kΩ	±0.25%			1
13	RMM0450	R. Metal	0.06W	1.111MΩ	±0.05%	1		
13	RMM0451	R. Metal	0.06W	1.111MΩ	±0.1%		1	
13	RMM0452	R. Metal	0.03W	1.111MΩ	±0.25%			1
14	RCR3343	R. Carbon	1/4W	510kΩ	±5%	1	1	1
15	RCR4950	R. Carbon	1/8W	10MΩ	±5%	1	1	1
16	RCR3326	R. Carbon	1/4W	100kΩ	±5%	1	1	1
17	RCR3330	R. Carbon	1/4W	150kΩ	±5%	1	1	1
18	RCR3314	R. Carbon	1/4W	33kΩ	±5%	1	1	1
19	RMM0430	R. Metal	1/4W	26.7kΩ	±1%	1	1	1
20	RMM0431	R. Metal	1/4W	274kΩ	±1%	1	1	1
22	RCR3278	R. Carbon	1/4W	1kΩ	±5%	1	1	1
23	RMM0432	R. Metal	1/2W	163.6Ω	±0.1%	1		
23	RMM0433	R. Metal	1/4W	163.6Ω	±0.25%		1	1
24	RMM0434	R. Metal	1/2W	1.637kΩ	±0.1%	1		
24	RMM0435	R. Metal	1/4W	1.637kΩ	±0.25%		1	1
25	RMM0456	R. Metal	1/2W	16.37kΩ	±0.1%	1		
25	RMM0457	R. Metal	1/4W	16.37kΩ	±0.25%		1	1
26	RMM0458	R. Metal	1/2W	163.7kΩ	±0.1%	1		
26	RMM0459	R. Metal	1/4W	163.7kΩ	±0.25%		1	1
27	RMM0453	R. Metal	0.3W	1.637MΩ	±0.5%	1	1	1
28	RMM0454	R. Metal	0.3W	16.35MΩ	±1%	1	1	1
29	RCR3326	R. Carbon	1/4W	100kΩ	±5%	1	1	1
30	RMM0436	R. Metal	1/4W	300Ω	±5%	1	1	1
31	RMM0437	R. Metal	1/4W	28.7kΩ	±5%	1	1	
32	RCR3340	R. Carbon	1/4W	390kΩ	±5%	1	1	1
33	RCR3336	R. Carbon	1/4W	270kΩ	±5%	1	1	1
34	RMM0438	R. Metal	1/4W	90kΩ	±1%	1	1	
35	RMM0439	R. Metal	1/4W	62kΩ	±1%	1	1	1
36	RMM0440	R. Metal	1/4W	9.1kΩ	±1%	1	1	1
37	RCR3306	R. Carbon	1/4W	15kΩ	±5%	1	1	1
38	RCR4950	R. Carbon	1/8W	10MΩ	±5%	1	1	
39	RMM0441	R. Metal	1/4W	1kΩ	±1%	1	1	
40	RMM0442	R. Metal	1/4W	2kΩ	±1%	1	1	
41	RMM0443	R. Metal	1/4W	82Ω	±1%	1	1	
41	RCR3230	R. Carbon	1/4W	10Ω	±5%			1
42	RCR3334	R. Carbon	1/4W	220kΩ	±5%	1	1	1
43	RCR3338	R. Carbon	1/4W	330kΩ	±5%	1	1	1
44	RMM0445	R. Metal	1/4W	22kΩ	±1%	1	1	1
45	RMM0445	R. Metal	1/4W	22kΩ	±1%	1	1	1
46	RMM0444	R. Metal	1/4W	20kΩ	±1%	1	1	1
47	RMM0455	R. Metal	0.3W	100MΩ	±10%	1	1	1
48	RCR3338	R. Carbon	1/4W	330kΩ	±5%	1	1	1
49	RCR3338	R. Carbon	1/4W	330kΩ	±5%	1	1	1
50	RCR3290	R. Carbon	1/4W	3.3kΩ	±5%	1	1	1

Symbol	Part Code	Description				Q'ty A	Q'ty B	Q'ty C
R 51	RCR3295	R. Carbon	1/4W	5.1kΩ	±5%	1	1	1
52	RCR3278	R. Carbon	1/4W	1kΩ	±5%	1	1	1
53	RCR3330	R. Carbon	1/4W	150kΩ	±5%	1	1	1
54	RCR4950	R. Carbon	1/4W	10MΩ	±5%	1	1	
55	RCR3280	R. Carbon	1/4W	1.2kΩ	±5%	1	1	1
VR 1	RNE0064	VR. Metal	EVM-38GB25			1	1	1
2	RNE0062	VR. Metal	EVM-38GB14			1	1	1
3	RNE0063	VR. Metal	EVM-38GB24			1	1	
4	RNE0060	VR. Metal	EVM-38GB13			1	1	1
5	RNE0061	VR. Metal	EVM-38GB53			1	1	
6	RNE0060	VR. Metal	EVM-38GB13			1	1	1
7	RNE0063	VR. Metal	EVM-38GB13			1	1	1
C 1	CQE0058	C. Plastic	50V	0.022μF		1	1	1
2	CQE0059	C. Plastic	50V	0.047μF		1	1	1
3	CQE0059	C. Plastic	50V	0.047μF		1	1	1
4	CSD0004	C. Ta Elyc	16V	0.47μF		1	1	1
5	CQE0057	C. Plastic	50V	0.01μF		1	1	1
6	CQE0057	C. Plastic	50V	0.01μF		1	1	1
7	CQE0061	C. Plastic	50V	0.22μF		1	1	1
8	CQE0061	C. Plastic	50V	0.22μF		1	1	1
9	CQE0061	C. Plastic	50V	0.22μF		1	1	1
10	CCR0167	C. Ceramic	50V	1 pF		1	1	1
11	CSD0004	C. Ta Elyc	16V	0.47μF		1	1	1
12	CSD0004	C. Ta Elyc	16V	0.47μF		1	1	1
13	CSD0003	C. Ta Elyc	16V	0.22μF		1	1	1
14	CCR0168	C. Ceramic	50V	390pF		1	1	1
15	CCR0170	C. Ceramic	50V	0.002μF		1	1	1
16	CQE0060	C. Plastic	50V	0.1μF		1	1	1
17	CQE0060	C. Plastic	50V	0.1μF		1	1	1
18	CEE0211	C. Al Elyc	35V	4.7μF		1	1	1
19	CEE0211	C. Al Elyc	35V	4.7μF		1	1	1
20	CCR0169	C. Ceramic	50V	39pF		1	1	1
21	CEE0212	C. Al Elyc	10V	47μF		1	1	1
22	CEE0212	C. Al Elyc	10V	47μF		1	1	1
IC 1	8404053	IC	MSM5230GS			1	1	1
Q 1	HTD0157	Transistor	2SD612			1	1	1
2	HTK0101	Transistor	2SK44			1	1	
3	HTK0100	Transistor	2SK304F			1	1	
4	HTK0101	Transistor	2SK44			1	1	
5	HTK0100	Transistor	2SK304F			1	1	
D 1-4	HDU0008	Diode	U05B			4	4	4
6-21	HDS0081	Diode	1S1588			16	16	
8-21	HDS0081	Diode	1S1588					14
DZ	HDT0054	Diode	TSC-9491AJ			1		
DZ	HDT0055	Diode	TSC-9491BJ				1	1
Z 1	HDT0053	Varister	TNR4A182K			1	1	1
PTC	HDX0053	Thermistor	911P97E101YU10			1	1	1
S 1-4	SSP0452	SW, PB	SK1005-0410Q			1	1	1
5	SSP0449	SW, PB	SPH-122-A3			1	1	1
6	SSP0450	SW, PB	SPH-121A-57			1	1	1
7-13	SSP0451	SW, PB	SK1005-0710Q			1	1	1
14	SSV0185	SW, Slide	A-003			1	1	1
LCD	8404052	LCD	LD-87073AZ			1	1	1
BZ	ESB0042	PKM11-4A0				1	1	1
X1	AAK003	X'tal	KF-38G (32.768 kHz)			1	1	1

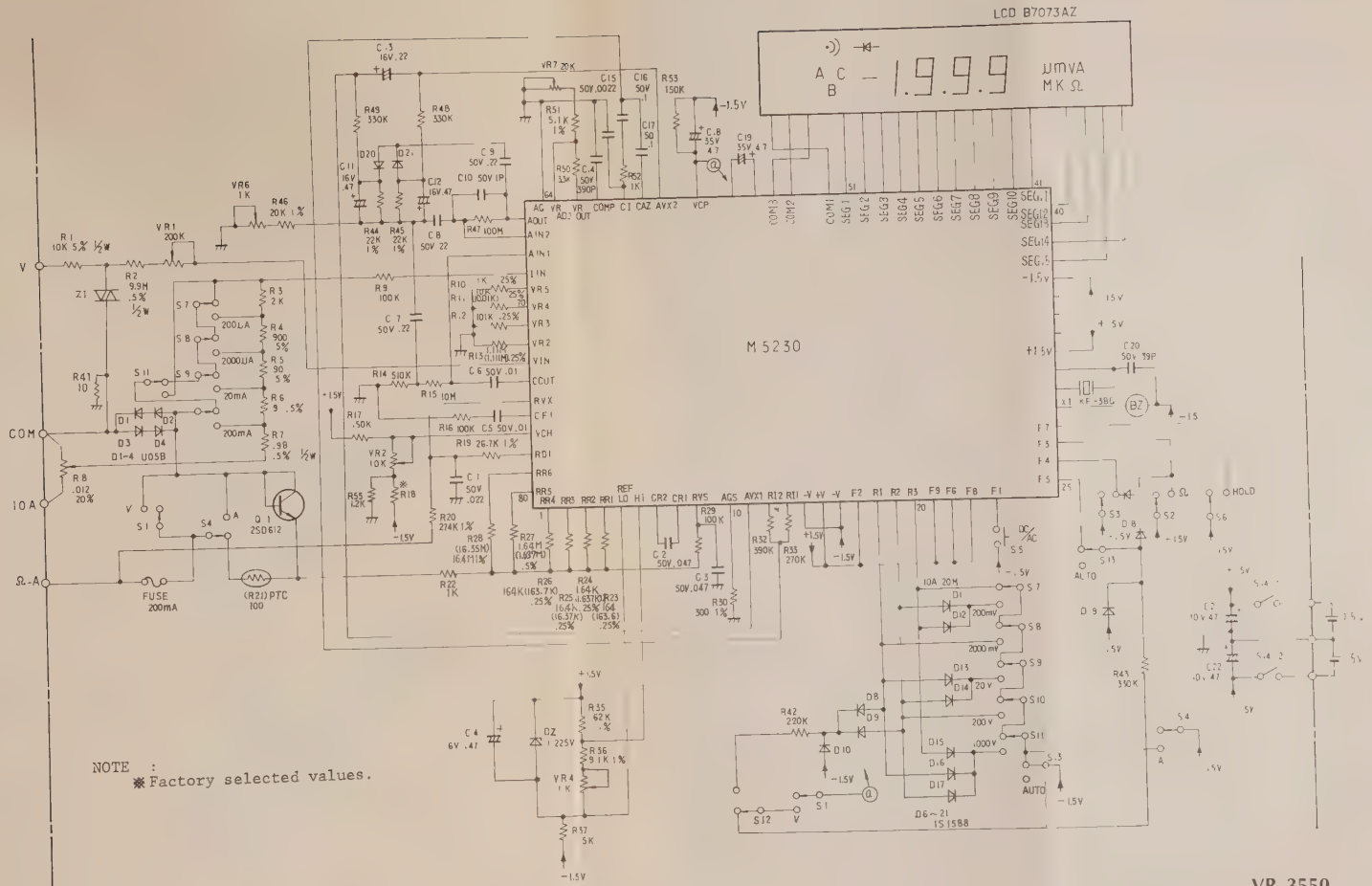
Symbol	Part Code	Description	Q'ty		
			A	B	C
	JYS0016	Post Terminal SDF-0.1-1.3AS	1	1	1
	ETS0159	Contact RT-01T-1.3B	1	1	1
	EFG0646	Fuse MF51NM2-10 (0.2A 250V)	1	1	1
	8404051	Test Code 4264	1	1	1
	EBA0001	Battery SUM-3 (SG) Ⓣ	1	1	1

10. SCHEMATIC DIAGRAMS


LCD B7073AZ
M5230
V
COM
10A
Ω-A
NOTE :
1. This is a cuircuitry diagram to illustrate the VR-3510.
The ✱markings indicate the parts where different components are used for the VR-3510 and VR-3525.
See the chart on the upper right corner of this diagram for a reference.
2. ✱Factory selected values.
D6~D21 is 1S1588

PART \ MODEL	VR-3510	VR-3525
R 2	9.9M .5% 1W	9.9M .5% ½W
R10	1 K . 05%	1 K . 1%
R11	10.01K .05%	10.01K .1%
R12	101K .05%	101K .1%
R13	1.111M .05%	1.111M .1%
DZ	1.225V 50PPm	1.225V 100PPm

VR-3510/3525
SCHEMATIC DIAGRAM

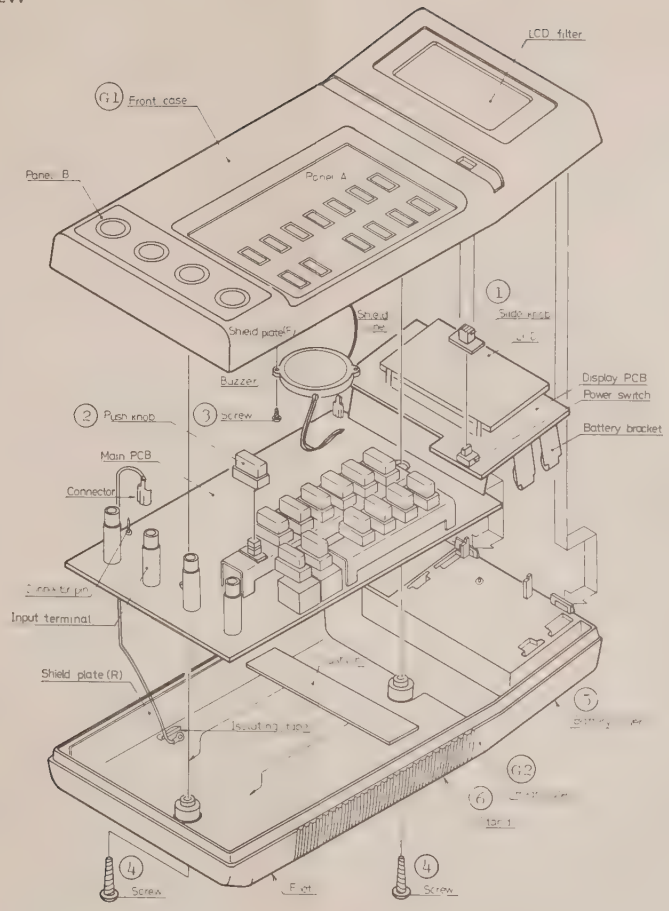


VR-3550
SCHEMATIC DIAGRAM

11. MECHANICAL PARTS LIST AND EXPLODED VIEW

Note
A:VR-3510/ B:VR-3525/ C:VR-3550

Symbol	Part Code	Description	Q'ty		
			A	B	C
G1	61M0005	Front Case Assy	1	-	-
	61M0006	Front Case Assy	-	1	-
	61M0007	Front Case Assy	-	-	1
G2	61M0008	Rear Case Assy	1	1	1
1	84CF152A	Slide Knob	1	1	1
2	84J6453A	Push Knob	13	13	13
3	84T0113A	Screw	1	1	1
4	XCA3236	Screw	1	1	1
5	33S2799A	Battery Cover	1	1	1
6	84J8912A	Stand	1	1	1



EXPLODED VIEW

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